DTU Library

Optimization of Permanent Magnet Assemblies

Insinga, Andrea Roberto; Bjørk, Rasmus; Smith, Anders; Bahl, Christian R.H.

Publication date:
2015

Document Version
Peer reviewed version

Citation (APA):
Insinga, A. R., Bjørk, R., Smith, A., & Bahl, C. R. H. (2015). *Optimization of Permanent Magnet Assemblies*. Abstract from Delft Days on Magneto Calorics, Delft, Netherlands.

Optimization of Permanent Magnet Assemblies

A. R. Insinga[1], R. Bjørk[1], A. Smith[1], C. R. H. Bahl[1]
[1]*DTU Energy - Technical University of Denmark*
aroin@dtu.dk

We present a framework for the optimization of segmented magnetic structures which can be used with any objective functional *S*, as long as all the materials exhibit a linear *B-H* relation.

Magnetic systems based on permanent magnet flux sources are fundamental in many scientific and technological applications[1], such as electro-mechanical energy conversion, magnetic refrigeration, beam physics, and medical imaging. In all these applications, the optimization of the magnetic system is of great importance. Many optimization algorithms, however, require a large number of evaluations of the objective functional and each evaluation requires the solution of the magnetic field equations for the considered geometry. This is often done by employing computationally expensive Finite Element Methods (FEM) and therefore many optimization algorithms are infeasible.

Our method is based on the linearity of the generated magnetic field with respect to the remanent flux density producing it. This is satisfied as long as all the materials of the system are working within the linear region of their *B-H* curves. If the geometry of the system is pre-determined, and the permanent magnet is divided into *N* uniformly magnetized segments, it is possible to compute the field generated by each segment in any point of space as a linear combination of the three components of its remanence vector. The total field is then given by the superposition of the individual field generated by each segment. This approach allows to quickly evaluate the objective functional *S* for any given configuration, and apply different optimization techniques, which would have otherwise been prohibitive.

We will demonstrate this approach by showing live our software that takes as input any 2D geometrical arrangement of magnets and then calculates in real time the optimal array of remanence directions for any input objective functional, allowing the user to chose between different optimization algorithms.

Key Words: Permanent Magnet, Optimization, Finite Element Method.

References :

[1] J.M.D. Coey, J. Magn. Magn. Mater. 248 (2002), 441-456